ABSTRACT

In a trench-gated MOSFET including an epitaxial layer over a substrate of like conductivity and trenches containing thick bottom oxide, sidewall gate oxide, and conductive gates, body regions of the complementary conductivity are shallower than the gates, and clamp regions are deeper and more heavily doped than the body regions but shallower than the trenches. Zener junctions clamp a drain-source voltage lower than the FPI breakdown of body junctions near the trenches, but the zener junctions, being shallower than the trenches, avoid undue degradation of the maximum drain-source voltage. The epitaxial layer may have a dopant concentration that increases step-wise or continuously with depth. Chained implants of the body and clamp regions permits accurate control of dopant concentrations and of junction depth and position. Alternative fabrication processes permit implantation of the body and clamp regions before gate bus formation or through the gate bus after gate bus formation.